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From Surface to Atmosphere – Ocean-Wave-Atmosphere interactions in a fully coupled environmental prediction model

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High impact weather is typically manifested through various interactions and feedbacks between different components of the Earth System. An accurate prediction and warning of the impacts of severe weather requires an integrated approach to forecasting and complex processes need to be understood for different weather situations from global to convective scale.
Sea surface temperature (SST) is an important factor in air sea interactions influencing local weather and climate but on the other hand however it is also controlled by atmospheric conditions. Ocean waves govern the exchange of momentum at the interface between ocean and atmosphere, modifying local wind speeds and vertical mixing in both ocean and atmosphere.
This presentation discusses results from a fully coupled high resolution probabilistic forecast system for the UK at km-scale, consisting of configurations of the Unified Model atmosphere, including the JULES land surface model, coupled to the NEMO ocean model and WAVEWATCH III wave model.
Our study focuses in particular on the impact of changing surface forcing resulting from changes in sea surface temperature and ocean surface on the representation of frontal systems over a UK domain. Assessing results from a number of contrasting case studies, we show that model coupling has a significant impact on the forecast timing of atmospheric fronts, modifying wind, wave and precipitation patterns. The sensitivity of the ocean state to changes in the atmospheric evolution resulting from coupling is explored comparing the fully coupled system to its uncoupled atmosphere, ocean and wave configurations. We use data from satellites, wave buoys and rain radar to verify the model results.